The objective of the soil treatment/adsorption system is to provide final treatment to wastewater effluent before release to the groundwater. In many ways, these systems can be thought of as groundwater recharge systems. Under non-ideal conditions, such as in course soils, high groundwater events, and subsurface channeling, wastewater may reach the groundwater or surface water before receiving adequate treatment. These conditions may lead to health impacts for persons who ingest or come into contact with the inadequately treated wastewater.

Many configurations of soil treatment systems have been used, including deep and shallow trenches, at-grade and above-grade (mound) systems, and spray irrigation. In addition, wastewater can be distributed in gravel filled trenches, without gravel (gravelless), or using drip irrigation to distribute wastewater to the root zone of plants. It is generally accepted that releasing wastewater in the upper soil horizons (where soil carbon and gas exchange are available) results in more effective wastewater polishing than wastewater release deeper in the soil environment.

The topics discussed in this section include (1) soil adsorption systems, (2) drip irrigation systems, (3) gravelless distribution systems, and (4) products for flow distribution.

11-1 Soil adsorption systems

Depending on the local hydraulic conditions, primarily the depth to the high groundwater, a number of options are available for selecting a location to release wastewater to the terrestrial environment. The three classifications for releasing wastewater are above [original] grade, at-grade or shallow, and below grade. Above grade systems are used in areas that have a seasonal or permanent high groundwater or other limiting soil condition, with the most common types being the mound system and the bottomless packed bed filter. At grade systems are less expensive because they do not require the import of soil or site excavation, but instead make use of the soil environment in a relatively undisturbed state. The below grade system is the most common. Soil adsorption systems and their applications are summarized in Table 11-1.

Table 11-1
Summary table of characteristics and applications of soil adsorption systems

		Applications		
System[a]	Provides treatment	High groundwater	Shallow limiting condition	Poor soils
At-grade		X	X	
Bed and trench				
Bottomless packed bed	X	X	X	X
Glendon biofilter	X	X	X	X
Mound	X	X	X	X
No-Mound	X	X		
Shallow		X		
Spray irrigation		X	X	X

[a] Designation of a system with an 'X' for a particular category indicates possible consideration for the corresponding application

11-1.1 At-grade systems

Category	Soil discharge/treatment system
Technology	Below grade discharge
Input	Primary and secondary wastewater
Function	Soil adsorption system
Applications	Discharge of effluent

Background
The at-grade system is an intermediate stage between the traditional trench leachfield and the mound type system. This system was developed in Wisconsin for areas with high groundwater, but without the limiting conditions which would require a mound system. The at-grade system resembles a mound type system without the sand layer.

Description of process
The area that will serve as the leachfield is tilled and covered with a layer of drainrock. The distribution pipe is placed in the drain rock, covered with a synthetic fabric, and covered with a final soil layer. Effluent is discharged by gravity or under pressure through the distribution piping and then infiltrated into the soil. Gravelless at-grade systems may eliminate the need to import aggregate drainrock.

System footprint
The area required for any distribution system will depend on the soils present at the site. In addition, this system requires a shallow soil mound to cover the distribution piping. The mound is often planted with ornamental landscaping plants.

Advantages
Makes use of the upper soil horizon for treatment and does not require the excavation of trenches. At-grade systems are compatible with areas that have limiting conditions where a trench would not be recommended.

Disadvantages
Soil clogging may result in surfacing wastewater earlier than it would in a comparably sized trench system. A shallow mound of soil will be visible where the system is located.

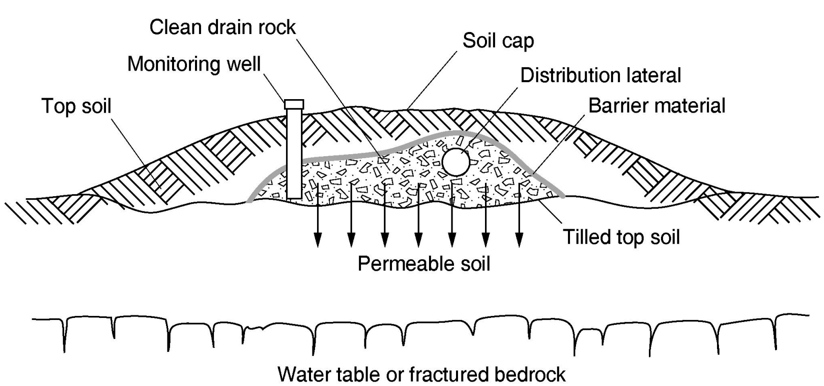

Figure 11-1

Diagram of a typical at-grade distribution system.

Operation and maintenance
Observation and sampling wells should be installed for monitoring of system.

Power and control
Effluent can be discharged under pressure or by gravity if appropriate.

Cost
Installation and construction of an at-grade soil adsorption system is expected to cost from $2,500 to 3,500, not including the septic tank. Overall cost will vary according to the availability of imported aggregate and soil.

References and other resources
Converse, J.C., M.E. Kean, E.J. Tyler, and J.O. Peterson (1991) Bacterial and nutrient removal in Wisconsin at-grade onsite systems, *Proceedings of the Sixth National Symposium on Individual and Small Community Sewage Systems*, American Society of Agricultural Engineers, St Joseph, MI.

Converse, J.C., E.J. Tyler, and J.O. Peterson (1990) Wisconsin at-grade soil adsorption system: siting, design, and construction manual, *Small Scale Waste Management Project*, University of Wisconsin, Madison.

11-1.2 Below-grade (trench and bed) systems

Category	Soil discharge/treatment system
Technology	Below grade discharge
Input	Primary and secondary wastewater
Function	Soil adsorption system
Applications	Discharge of effluent

Background
The trench system is the most common form of wastewater discharge to the soil. Trenches have been constructed at depths ranging from less than 1 ft (shallow) to 5 ft, with a width typically between 1 and 3 ft. The bed system is similar to the trench system; however, a large area is excavated for the wastewater distribution system instead of discrete trenches. Infiltration beds are not as effective as trenches on sloped sites. The discharge of wastewater in the upper soil horizons can potentially make use of soil carbon and increased microbial activity for the transformation of wastewater constituents. Shallow distribution systems may utilize aggregate for wastewater distribution; however, gravelless systems are also common. Gravelless systems use large diameter corrugated drain pipe or sections of half pipe to drain water into the soil (see Sec. 11-3).

Description of process
Trenches are generally filled with an aggregate support material, although chamber systems and other alternate systems are becoming more common. Wastewater is discharged to the trench by gravity or under pressure. The wastewater infiltrates through the bottom and sides of the trench, gradually forming a clogging/treatment layer of biological solids. For the bed system, a large, usually continuous, area is excavated and partially backfilled with aggregate. A system of perforated pipes is placed on the aggregate, followed by a geotextile fabric or similar material and covered with soil. Wastewater is discharged through the perforated pipes and infiltrated through the bottom of the trench or bed.

System footprint
Systems are generally sized according to the soil type and specific site conditions. A typical system may be between 500 and 2,500 ft^2, depending on site conditions and wastewater quality.

Advantages
Relatively low maintenance systems, typically gravity flow. Design criteria are well established

due to long history of use. Gravelless systems may be used, eliminating the need to import aggregate.

Disadvantages
Systems that are buried deep in soil are less effective at providing treatment to wastewater, potentially resulting in negative groundwater impacts. The area for infiltration is reduced for bed systems due to the presence of additional side area for trenches. Bed systems should not be used on sloped sites. Limited by soil characteristics at site, low permeability soils or high groundwater conditions may require a modified or alternative soil discharge system.

Operation and maintenance
Observation ports should be installed for periodic inspection of the infiltrative surface.

Power and control
Pressure distribution not required, but may be used to obtain more uniform distribution or for a remote soil adsorption field.

Cost
Typical installation and construction costs between $1,000 and 2,000 not including the septic tank or treatment system. The cost to import drainrock will influence the overall cost of an aggregate based system. The cost of a bed systems is typically less than the cost of trenches. Shallow systems are also less costly to install than deep systems.

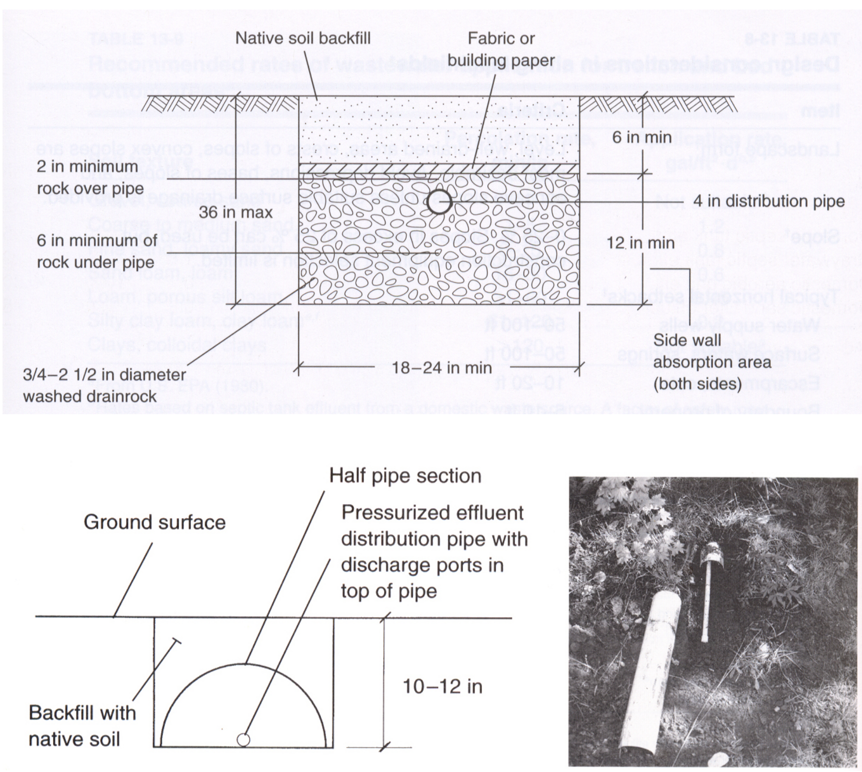

Figure 11-2

Diagrams of typical below-grade soil adsorption systems typical trench system (top) and shallow gravelless distribution system (bottom left) and a shallow gravelless distribution system with half pipe section removed. (Adapted from Crites and Tchobanoglous, 1998).

References and other resources
U.S. EPA (1980) Design Manual: Onsite Wastewater Treatment and Disposal Systems, EPA/625/1-80-012, Office of Water, Office of Research Development, United States Environmental Protection Agency, Washington DC.

U.S. EPA (2002) Onsite Wastewater Treatment Systems Manual, EPA/625/R-00/008, Office of Water, Office of Research Development, United States Environmental Protection Agency, Washington DC.

11-1.3 Bottomless packed bed filters

Category	Soil discharge/treatment system
Technology	Aerobic biofilter
Input	Effluent from septic tank or other primary treatment
Function	Treatment/distribution
Applications	Discharge of effluent

Background
Packed bed filters (such as the biofilter systems discussed in Chap. 6) can be constructed without a bottom and allowed to discharge the treated wastewater directly into the soil below the unit.

Description of process
Effluent from a septic tank or other primary treatment process is distributed to the surface of an intermittently dosed packed bed (biofilter) treatment process. After passing through the biofilter media, the water flows directly into the soil below.

System footprint
The area required for the discharge system is equivalent to the area of the bottomless packed bed filter system (see Chap. 6).

Advantages
Does not require construction of separate soil discharge area. Wastewater receives treatment before release into the environment.

Disadvantages
Clogging of the soil infiltration system (located below the packed bed filter) may be difficult to repair.

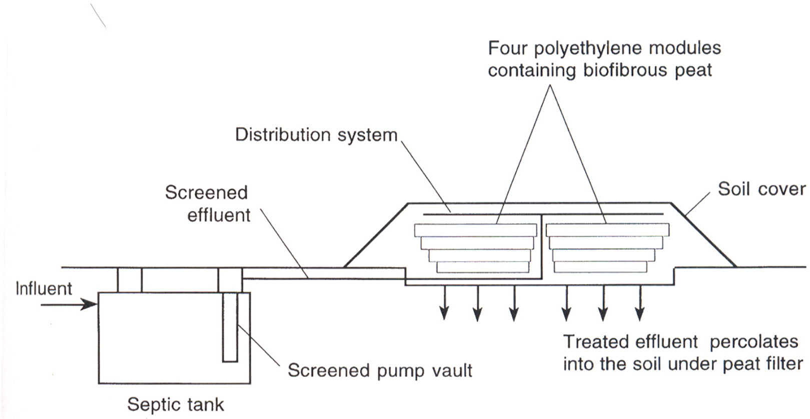

Figure 11-3

Diagram of a bottomless trickling biofilter system utilizing peat biofilter modules. (Adapted from Crites and Tchobanoglous, 1998.)

Performance
The bottomless packed bed filter provides (single-pass) treatment to wastewater before discharge to the soil. The performance before infiltration can be expected to be similar to that for the biofilter systems described in Chap. 6.

Operation and maintenance
Requirements for operation and maintenance will depend on the specific system, however, will be similar to the operation and maintenance outlined in Chap. 6.

Power and control
Pressure distribution will require a pump vault and the operation of a pump for wastewater delivery to the filter system.

Cost
The cost of the soil component of the bottomless packed bed system will no minimal compared to the biofilter treatment component.

References and other resources
Crites, R., and G. Tchobanoglous (1998) *Small and Decentralized Wastewater Management Systems*, WCB/McGraw-Hill, New York.

11-1.4 Glendon Biofilter®

Category	Soil discharge/treatment system
Technology	Anaerobic/aerobic biofilter
Input	Effluent from septic tank or other primary treatment
Function	Treatment/distribution
Applications	Treatment/discharge of effluent from septic tank

Background
The Glendon Biofilter system is a unique and effective treatment and distribution system. Wastewater is discharged from a septic tank or other primary treatment process to an anaerobic upflow biofilter system. After passing through the anaerobic stage, the water flows through a soil berm and into the natural soil. For additional details on the Glendon Biofilter, see Sec. 5-2.1.

Glendon BioFilter Technologies, Inc.
25448 Port Gamble Road N.E.
Poulsbo, WA 98370
E info@glendon.com

11-1.5 Mound systems

Category	Soil discharge/treatment system
Technology	Aerobic biofilter
Input	Effluent from septic tank or other primary treatment
Function	Treatment/distribution
Applications	Discharge of effluent

Background
Mounds were developed at the North Dakota Agricultural College in the 1940s. The mound systems were designed to overcome the limitations of soil discharge in areas with high groundwater, low permeability soils, and shallow soils over fractured or porous bedrock. Mounds have also been used in areas with steep slopes.

Description of process

The mound system is composed of a bed of sand and an effluent distribution system. The area to receive the mound system is tilled to break up the surface layer of the soil. A wastewater distribution system and an underlying bed of sand are placed on top of the tilled soil for treatment of the wastewater. The distribution system is covered with a geotextile fabric or similar material and a low permeability cap soil for cold weather protection. The system is then covered with soil and landscaped. Wastewater is then discharged (by gravity or under pressure) to the mound system for aerobic treatment before infiltration into the soil.

System footprint

Mounds typically range from 300 to 500 ft^2, with a height of 2 to 3 ft.

Advantages

The mound system makes it possible to provide treatment to wastewater before release into non-ideal soils, such as areas with high ground water, low permeability soils, and areas with highly porous bedrock at shallow depths. Design and use is well established.

Disadvantages

May be expensive to procure all materials needed for implementation (sand and gravel). Clogging may result in odors and wastewater surfacing. In flat areas, wastewater will need to be pumped because of elevated nature of mound. Large mounded area may require integration into landscape to avoid aesthetic concerns.

Performance

Effluent from mound systems (infiltrated into soil) expected to be comparable to single-pass sand filters of similar depth.

Operation and maintenance

Observation ports necessary for inspection of system operation. Any pumps and/or control systems will need periodic maintenance as determined by manufacturer.

Power and control

Low pressure pumps often used to deliver wastewater to mound system. Standard mound system does not utilize any internal power and control facilities.

Cost

The estimated cost to construct a mound system (not including the septic tank) is in the range of $10,000 to 15,000. Operation of a low head pump can be expected to use about 100 to 300 kWh per year.

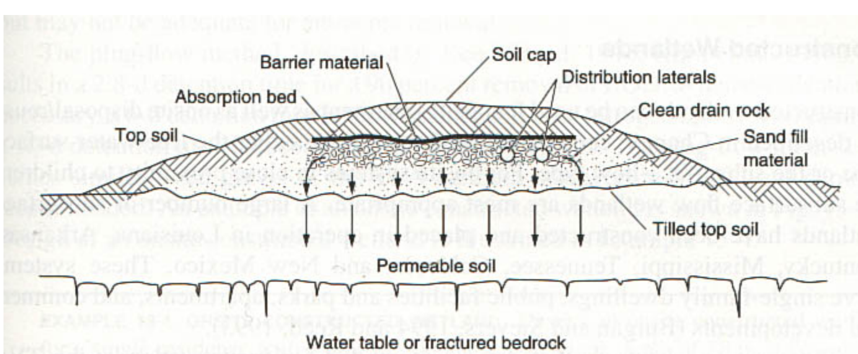

Figure 11-4

Diagram of a mound system for wastewater treatment and dispersal.
(Adapted from Crites and Tchobanoglous, 1998.)

11-1.6   NoMound® Systems

Category	Soil discharge/treatment system
Technology	High groundwater soil adsorption system
Input	Effluent from septic tank or secondary/advanced treatment
Function	Treatment/distribution
Applications	Discharge of effluent

Background
The basic NoMound onsite system is an alternative to the elevated sand mound for any location with a seasonal or regional high water table.

Description of process
A geomembrane enclosure is installed around the sides and top of the drainfield or trenches leaving the bottom open. The sidewalls of the geomembrane enclosure are installed deep enough so that the lowered groundwater level inside the NoMound forms a water seal which prevents air from flowing out of the bottom of the enclosure. Air is introduced inside of the geomembrane cap, lowering the groundwater table and creating an unsaturated zone for aerobic wastewater treatment.

System footprint
The space required for the NoMound system is the same as that needed for a conventional soil adsorption system.

Advantages
In areas with high groundwater, the NoMound system can be used as an alternative to imported aggregate/sand mounds. Because the system is installed completely underground, above ground mounds are not needed. The air supply to control the water level may also improve the treatment process in the soil.

Disadvantages
Requires an air compressor to control water level. If the geomembrane becomes punctured it will need to be repaired for proper system operation.

Figure 11-5

The complete NoMound system before the final soil cover is applied. (Adapted from the Oak Hill Company, Ltd.)

Operation and maintenance
Standard operation and maintenance is needed, similar to that for a typical soil adsorption system. In addition, the system requires periodic (6 month) inspection of the air compressor (cleaning or replacement of the air filter and check valve. The water level monitoring system should also be checked for proper operation.

Power and control
An air compressor operating half time is expected to use about 100 kWh annually. A water level monitoring device and alarm are used in case of system malfunction.

Cost
System will cost $1,000 to 2,000 in addition to the cost of the standard soil adsorption system and installation of the system.

Contact
The Oak Hill Company, Ltd.
Great Valley Corporate Center
5 Great Valley Parkway Suite 239
Malvern PA 19355
Phone   (610) 648-6270
Fax   (610) 644-7048
Web   www.nomound.com

References and other resources
NoMound Product Brochure (2001).

11-1.7   Spray irrigation

Category	Soil discharge/treatment system
Technology	High groundwater soil adsorption system
Input	Disinfected effluent from secondary/advanced treatment system
Function	Distribution, irrigation
Applications	Residential, commercial, institutional

Background
The use of spray irrigation for the discharge of wastewater is somewhat limited due to the potential for human contact. Because the system is suited for areas with high year round water demands, it is not appropriate for all areas.

Description of process
Wastewater that has been treated in a secondary or advanced treatment process and disinfected is collected in a holding tank and periodically pumped from the holding tank to surface spray nozzles. The irrigation system is designed to apply water evenly to the landscape, similar to a conventional lawn irrigation system.

System footprint
The size of the system needed depends on the wet weather irrigation needs, so will vary by climatic zone and amount of wastewater to be discharged.

Advantages
Spray irrigation is a form of beneficial water reuse. In appropriate climates, spray irrigation can be used independent of soils provided that the soil can support vegetation, even in soils not suitable for soil adsorption systems. Studies have concluded that there is a minimized possibility for groundwater impacts when using spray irrigation with onsite treatment systems. More of the available land area can be utilized.

Disadvantages
Increased potential for human contact will necessitate frequent system monitoring/maintenance to ensure safety. In dry weather, additional water will be needed to meet irrigation demands. May be more energy intensive than some other alternatives due to the need to secondary/advanced treatment and pressure distribution. Requires minimum lot size.

Performance
Spray irrigation systems have been found to have negligible impacts on groundwater and surface water from runoff. Plant uptake has been identified as a significant removal mechanism of nitrogen.

Operation and maintenance
Spray irrigation systems require a maintenance contract to ensure the protection of human health and environmental safety. Servicing several times a year, including monitoring of onsite treatments systems, disinfection facilities, and spray irrigation systems is needed. Monitoring of subsurface and runoff water should be conducted.

Power and control
In addition to treatment system needs, the spray irrigation system will require a collection sump and pump to distribute the water to the spray nozzles.

Cost
In addition to the costs for secondary/advanced treatment and disinfection, installation of a spray irrigation system will typically cost about $1,500. Operation and maintenance costs will range from $300 to 600 a year.

Figure 11-6

A spray irrigation system installed at a home, systems can also be installed with low trajectory spray nozzles installed at ground level. (Adapted from the Virginia Department of Health.)

Contact
K-Rain Manufacturing Corporation
1640 Australian Avenue
Riviera Beach, Florida 33404
Phone   (561) 844-1002; (800) 73k-Rain
Fax   (561) 842-9493
E   Krain@K-Rain.Com
Web   www.k-rain.com/

Figure 11-7
Pop-up style spray irrigation emitters for wastewater. (Adapted from K-Rain Manufacturing Corporation.)

References and other resources

Lesikar, B. (1999) Onsite Wastewater Treatment Systems: Spray Irrigation, Texas Agricultural Extension Service, Texas A&M University System. (this and other onsite fact sheets available at texaserc.tamu.edu/catalog/topics/Waste_Management.html).

McIntyre, C., C. D'Amico, and J.H. Willenbrock (1994) Residential Wastewater Treatment and Disposal: On-Site Spray Irrigation Systems, *Proceedings of the Seventh International Symposium on Individual and Small Community Sewage Systems*, American Society of Agricultural Engineers, St. Joseph, MI.

Monnett, G.T., R.B. Reneau, and C. Hagedorn (1991) Evaluation of onsite sewage spray irrigation on marginal soils, *Proceedings of the Sixth International Symposium on Individual and Small Community Sewage Systems*, American Society of Agricultural Engineers, St. Joseph, MI.

Rubin, A.R., and B.L. Carlile (1991) Slow rate spray irrigation treatment facilities for individual homes, *Proceedings of the Sixth International Symposium on Individual and Small Community Sewage Systems*, American Society of Agricultural Engineers, St. Joseph, MI.

11-2 Drip irrigation systems

A subsurface drip irrigation system is used to apply wastewater to soil in a way that allows plants to utilize the water. Drip irrigation can be a reliable and effective method for the distribution of wastewater from onsite wastewater treatment systems to the surrounding environment.

Description of process

Drip irrigation systems for wastewater discharge typically consist of a treatment process, a pump, and the drip tubing with emitters. The treatment process needed depends on manufacturer of the drip system, but typically consists of a secondary/advanced treatment system. However, some drip systems are designed for use with screened septic tank effluent. The wastewater is collected in a sump and pumped through the drip tubing. Anti-siphon valves are placed at the high points in the drip irrigation network to prevent backflow of soil particles into the emitters.

System footprint

The size of a drip irrigation system is dependent on the amount of wastewater to be discharged and the characteristics of the soil; however, these systems are adaptable to almost all landscapes.

Advantages

Wastewater is distributed uniformly around landscape. Shallow placement of drip emitters (typically 6 in) allows for improved treatment and plant uptake of wastewater. Drip irrigation systems are an established technology.

Disadvantages

Drip irrigation systems are somewhat mechanically intensive and often use filtration devices that require periodic maintenance for proper operation. Drip emitters are small and can become clogged with particles in wastewater. Root intrusion may also be a concern for systems that do not incorporate a pesticide into the design.

Performance

Performance is expected to be better than deep trenches and comparable to shallow pipe soil adsorption systems. Because wastewater is often treated in a secondary/advanced treatment process prior to drip distribution, the wastewater discharged is typically of higher quality than septic tank effluent.

Operation and maintenance

Proper and regular maintenance is critical for drip irrigation systems. Particle filter devices need to be checked for proper operation and cleaned or replaced as necessary. Drip lines should be flushed periodically. Many systems incorporate timers and controls for automated operation, for these systems the controls and timers should be checked for proper operation.

Power and control

Typical system components include pumps and process control devices. System manufacturers and designers should be contacted for specific design details. Annual energy needs for drip irrigation controls and pumping expected to be from 500 to 1,000 kWh.

Cost

The cost to install a drip irrigation systems at a residential site can range from $2,000 to more than $10,000, in addition to primary and secondary treatment systems. The cost is a function of market variables and the degree of sophistication involved.

11-2.1   AQUA DRIP

Hydro-Action, Inc.
8645 Broussard Rd.
Beaumont, TX 77713
Phone   (409) 892-3600
Fax   (409) 892-0005
Web   www.hydro-action.com
Model description

Wastewater from a secondary treatment process is filtered through a backwashing sand filter before discharge to the drip irrigation system.

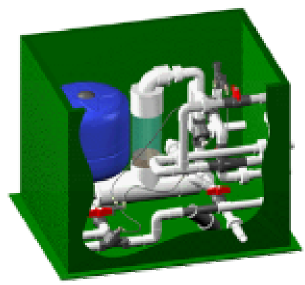

Figure 11-8

The AQUA DRIP Wastewater Effluent Management System. (Adapted from Hydro-action, Inc.)

11-2.2   BioLine

Netafim Irrigation, Inc.
5470 E. Home Avenue
Fresno, CA 93727
Phone   (559) 453-6800
Fax   (800) 695-4753
Web   www.netafim-usa-wastewater.com
Description

Drip irrigations systems with pressure compensating emitters and self-flushing feature to provide uniform flow and resist clogging

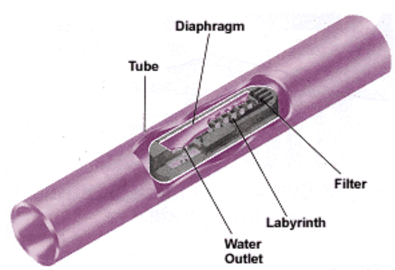

Figure 11-9

A cross-section of the BioLine drip line showing the pressure compensating emitter. (Adapted from Netafim Irrigation, Inc.)

11-2.3   Drip-Tech

P. 0. Box 5814
Austin Texas 78763
Phone   (512) 329-0066
E   goldberg@io.com
Web   www.drip-tech.com
Description

Drip-Tech designs utilize Bioline and automatic backwashing disk filters.

Figure 11-10

A typical side trench shown during installation of a drip irrigation system. (Adapted from Drip-Tech.)

11-2.4 Perc-rite

Waste Water Systems, Inc.
P.O. Box 1023; 64 Sailors Drive, Suite 114
Ellijay, GA 30540
Phone (706) 276-3139
Fax (706) 276-6535
E info@wastewatersystems.com
Web www.wastewatersystems.com;
Description
Process for drip irrigation of septic tank effluent or secondary/advanced treatment process effluent

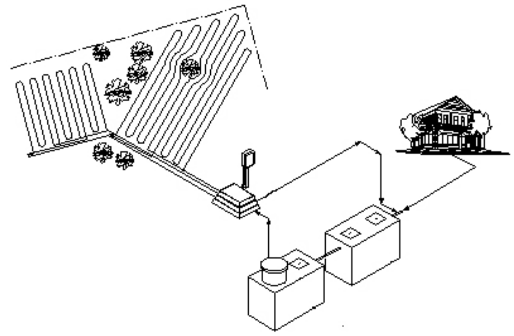

Figure 11-11

The Perc-rite system for drip irrigation of septic tank effluent (Adapted from American Manufacturing, Inc.)

11-2.5 Wasteflow

Geoflow, Inc.
200 Gate 5 Road #103
Sausalito CA 94966
Phone (415) 331-0166
Fax (415) 331-0167
Web www.geoflow.com
Description
Drip systems incorporating large orifice, biocide to inhibit biofilm growth in dripline, and herbicide to prevent root growth into emitters.

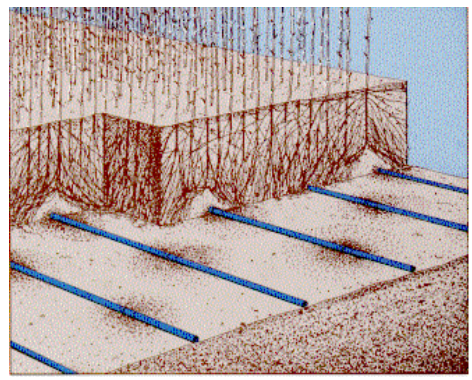

Figure 11-12

Diagram showing effects of Treflan herbicide on root growth around drip emitters. (Adapted from Geoflow, Inc.)

11-3 Gravelless distribution products

In addition to drip irrigation systems, a variety of products are available for the distribution of wastewater without gravel or other aggregate fill materials. The most common types of products are chambers (large half-pipe sections buried underground to form a cavern for wastewater infiltration) and drainpipe wrapped with a geotextile or alternate material.

Background

Gravelless systems are used as a replacement for the gravel adsorption system for the subsurface infiltration of treated effluents into the soil. The primary use for gravel in conventional systems is to provide structural support to the trench sidewalls and pipe, however, gravel is believed to decrease the overall infiltrative surface area and wastewater storage volume in the trench.

Description of process

The two basic types of gravelless systems are leaching chambers and drainage pipe. The process water is typically distributed by gravity (without lateral pipes), but may be dosed under pressure in pipe with drilled orifices. The water then infiltrates into the surrounding soil. Chamber systems have also been used as distribution systems for trickling (packed-bed) biofilters and above-grade (mound) effluent distribution systems. Technical guidelines for installation and use are available from the manufacturer.

System footprint
The system size needed depends on the soil properties at the site as well as the quantity and quality of wastewater generated. The overall area required for a gravelless systems should be equal to or less than the area needed for an aggregate based trench systems.

Advantages
Potential for reduction in the overall area required for soil dispersal of wastewater compared to gravel based systems. Installation requires less time and expense than gravel based systems. Inspection ports should be included to allow for monitoring of infiltration process. Products typically manufactured from recovered plastic. May be favorable in areas where it is expensive to import aggregate.

Disadvantages
Use of gravelless system does not eliminate possibility of soil clogging. Impact of increased infiltration rate on soil treatment systems requires additional research.

Performance
Gravelless systems have been installed at many locations in all parts of the country. The performance is typically dependent on the upstream treatment processes and the site specific factors, such as soil type and water table depth. A review of the field performance of chamber leaching systems by third parties and Infiltrator Systems staff reported the following results (Dix and May, 1998):

> Over 550,000 chamber leaching systems are in use (Infiltrator Systems, Inc., 2001).
> Properly designed systems could be operated with reduced adsorption area.
> Of the chamber systems evaluated for the study, most of the systems were found to be utilizing only 50% of the available surface area for adsorption, when sized according to specifications for gravel systems.
> In addition, it was noted that system failures were due to site conditions including (1) high ground water table, (2) surface flooding and infiltration, and (3) poor soils.

Operation and maintenance
Systems are generally installed below ground and should not require maintenance except in the event of soil clogging. Access ports should be installed to allow for monitoring of system hydraulic performance. Gravelless systems do not require regular maintenance, and thus are not typically installed with inspection facilities; however, the presence of inspection ports would facilitate monitoring activity.

Power and control
Gravelless systems may be used with gravity flow systems or pressure distribution systems.

Cost
The installation and construction costs for a gravelless system are typically range from $1,000 to 2,000, not including the septic system or other treatment devices.

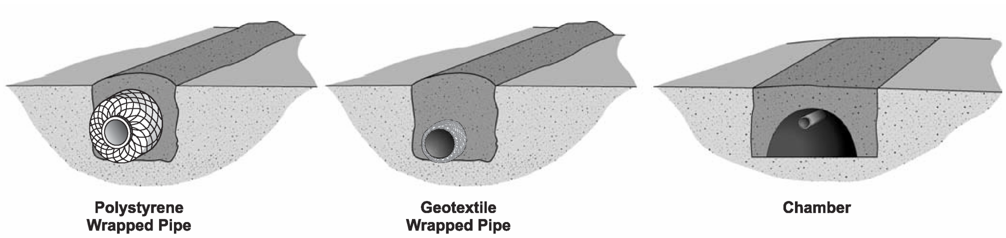

Figure 11-13

Three types of gravelless soil adsorption systems. (Adapted from U.S. EPA, 2001.)

11-3.1 Biodiffuser

ADS, Inc. (Advanced Drainage Systems)
4640 Trueman Boulevard
Hillard, OH 43026
Phone (800) 821-6710
E info@ads-pipe.com
Web www.ads-pipe.com
Model description
Manufactures standard and high capacity leaching chamber systems

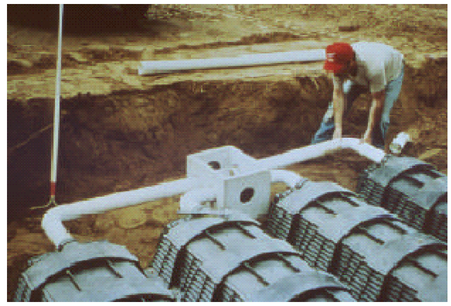

Figure 11-14

Installation of the Biodiffuser chamber system. (Adapted from ADS, Inc.)

11-3.2 Cultec Contactor and Recharger

Cultec, Inc.
PO Box 280; 878 Federal Road
Brookfield, CT 06804
Phone (203) 775-4416; (800) 4CULTEC
Fax (203) 775-1462; (203) 775-5887
E custservice@cultec.com
Web www.cultec.com
Model description
A variety of leaching chamber sizes for storm water storage and wastewater infiltration.

Figure 11-15

Several models of Cultec chambers. (Adapted from Cultec, Inc.)

11-3.3 Enviro-Septic®

Presby Environmental
PO Box 617 Route 117
Sugar Hill, NH 03585
Phone 800-473-5298
Fax 603-823-8114
Web www.PresbyEnvironmental.com
Model description
Corrugated drainage pipe with a 12 in diameter wrapped with a polypropylene mat and polypropylene fabric.

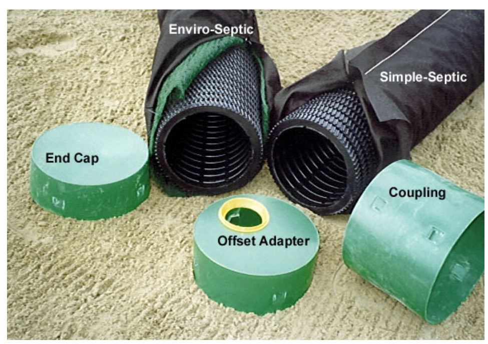

Figure 11-16

The Presby Enviro-Septic and Simple-Septic. (Adapted from Presby Environmental, Inc.)

11-3.4 Envirochambers

Hancor, Inc.
Phone (888) 367-7473
Fax (888) 329-7473
E drainage@hancor.com
Web www.hancor.com
Model description
Chamber systems and corrugated drainage pipe wrapped with filter fabric.

Figure 11-17

Drainage and infiltration products from Hancor. (Adapted from Hancor, Inc.)

11-3.5 EZFlow

EZflow, LP
65 Industrial Park
Oakland, TN 38060
Phone (877) 368-8294
Fax (901) 465-1181
E tinac@ezflowlp.com
Web www.ezflowlp.com
Description

The EZflow drain basic unit is a 10 ft length of 4 in perforated corrugated plastic pipe surrounded by a geo-synthetic aggregate, held together by polyethylene netting 6, 10 and 12 in in diameter.

Figure 11-18

Installation of an EZFlow drainage system. (Adapted from EZflow, LP.)

11-3.6 Goldline GLP

Prinsco, Inc.
108 West Highway 7, PO Box 265
Prinsburg, MN 56281
Phone (320) 978-8602; (800) 992-1725
Fax (320) 978-8602
E info@prinsco.com
Web www.prinsco.com
Description

Corrugated polyethylene tubing covered in geotextile fabric

Figure 11-19

Goldline drainage pipe used for gravelless wastewater infiltration systems. (Adapted from Prinsco, Inc.)

11-3.7 In-Drains®

Eljen Corporation
125 McKee St
East Hartford, CT 06108
Phone (800) 444-1359
(860) 610-0426
Fax (860) 610-0427
E questions@eljen.com
Web www.eljen.com
Model description

The In-Drain system is composed of a cuspated plastic and geotextile fabric bundled together with an effluent distribution pipe. The system provides single-pass treatment to wastewater before infiltration into the soil. In addition to its use in soil adsorption systems, similar products are available for storm water runoff storage capacity and for curtain drain application.

Figure 11-20

The In-Drains system for the treatment and infiltration of wastewater. (Adapted from Eljen Corporation)

11-3.8 Infiltrator

Infiltrator Systems Inc.
P.O. Box 768; 6 Business Park Road
Old Saybrook, CT 06475
Phone 800-221-4436
860-577-7000
Fax 860-577-7001
E info@infiltratorsystems.com
Web www.infiltratorsystems.com

Description

Infiltrator Systems provides product technical information, reference library, design review, and testing. Company representatives are available throughout North America to provide training, education, and maintenance of local product distribution outlets. A standard one year limited warranty is included on chambers and endplates, offering product replacement in the event of defective products. Infiltrator Systems, Inc. also manufactures endplates and products to accommodate angled connecting joints and side by side chamber orientation.

Figure 11-21
Installation of Infiltrator chamber systems. (Adapted from Infiltrator Systems Inc.)

References and other resources

Dix, S., and R. May (1998) A review of field performance of chamber leaching systems, Infiltrator Systems, Inc.

U.S. EPA (2002) EPA Municipal Technology Branch: Decentralized Systems Technology Fact Sheet on Septic Tank Leaching Chamber, EPA 832-F-00-04, U.S. Environmental Protection Agency, Washington, DC.

11-4 Flow distribution products

A variety of products are available to provide flow balancing and flow dosing. Flow balancing ensures that a section of the soil adsorption system is not overloaded or can alternate dosing between two or more zones. Flow dosing discharges wastewater in discreet doses, allowing for aeration between doses and the potential for flow metering. The devices outlined in this section do not require electrical components for operation.

System footprint

Flow distribution devices are typically housed inside of a pump tank or distribution box.

Advantages

Improved distribution of wastewater may enhance the ability of the soil adsorption system to provide treatment. The systems below do not require electricity.

Disadvantages

Adding distribution components will increase the maintenance needs of an onsite treatment system.

Operation and maintenance
Depending on the specific component, typical maintenance consists of periodic inspection to confirm proper operation according to manufacturer instructions. Some valves are manually operated.

Cost
Flow distribution devices are typically less than $100.

11-4.1 Bull Run Valve
American Manufacturing Company, Inc.
P.O. Box 549
Manassas, Va. 20108-0549
Phone (800) 345-3132
Fax (703) 754-0058
E info@americanonsite.com
Web www.americanonsite.com
Product description
The Bull Run Valve is used to divert flow between two soil adsorption systems. Valve operation does not require exposure to wastewater.

Figure 11-22
The Bull Run Valve for flow control in distribution systems. (Adapted from American Manufacturing Company, Inc.)

11-4.2 Dial-A-Flow
American Manufacturing Company, Inc.
P.O. Box 549
Manassas, Va. 20108-0549
Phone (800) 345-3132
Fax (703) 754-0058
E info@americanonsite.com
Web www.americanonsite.com
Product description
Typically placed inside of the distribution box over a pipe inlet. Rotating the Dial-A-Flow increases or decreases flow rate.


Figure 11-23
The Dial-A-Flow valve. (Adapted from American Manufacturing Company, Inc.)

11-4.4 Dosing siphons
American Manufacturing Company, Inc.
PO Box 549, Manassas, Va. 20108-0549
Phone (800) 345-3132
Fax (703) 754-0058
E info@americanonsite.com
Web www.americanonsite.com

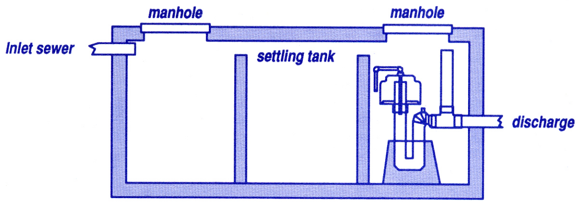

Figure 11-24
Diagram of an automatic dosing siphon used to provide discreet dosing in gravity flow systems. (Adapted from Fluid Dynamics Siphons, Inc.)

Fluid Dynamic Siphons, Inc.
PO Box 882019, Steamboat Sprgs, CO 80488
Phone (303) 879-2494
Fax (303) 879-4948
E fluiddyn@cmn.net

Orenco Systems, Inc.
814 Airway Avenue, Sutherlin, OR 97479
Phone (800) 348-9843; (541) 459-4449
Fax (541) 459-2884
Web www.orenco.com

11-4.5 Hydrotek valve

K-Rain Manufacturing Corp.
1640 Australian Avenue
Riviera Beach, FL 33404
Phone (561) 844-1002
Fax (561) 842-9493
Web www.k-rain.com
Description
Automatically advances to the next zone (4 to 6 zone models) each time the pump is activated.

Fig 11-25

The Hydrotek valve for flow distribution. (Adapted from K-Rain Manufacturing Corp.)

11-4.6 Polylok Dipper

PolyLok, Incorporated
173 Church Street
Yalesville, CT 06492
Phone (203) 269-3119x20
Fax (203) 265-4941x20
Web www.polylok.com
Product description
Fill and empty cycle provides discreet dosing in gravity flow systems.

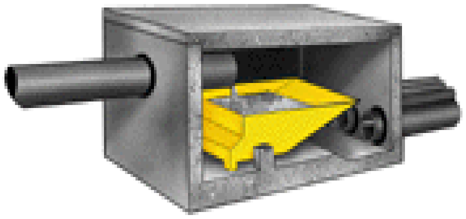

Figure 11-26

Illustration of the Polylok Dipper. (Adapted from Polylok, Inc.)

11-4.6 Polylok Equalizer

PolyLok, Incorporated
173 Church Street
Yalesville, CT 06492
Phone (203) 269-3119x20
Fax (203) 265-4941x20
Web www.polylok.com
Product description
Equalizer provides adjustable flow rate control from distribution boxes.

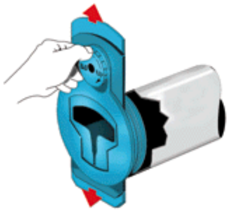

Figure 11-27

Illustration of the Polylok Equalizer. (Adapted from Polylok, Inc.)

1-4.7 Tuff-tite

Tuff-Tite Corporation
500 Capital Drive
Lake Zurich, IL 60047
Phone (847) 550-1011; (800) 382-7009
Fax (847) 550-8004
E sales@tuf-tite.com
Web www.tuf-tite.com
Product description
An assortment of distribution boxes and gas baffles

Figure 11-28

Tuf-tite drainage and septic products. (Adapted from Tuf-Tite Corporation, Inc.)

11-4.8   Zabel

Zabel Environmental Technology
PO Box 1520
Crestwood KY 40014
Phone   (502) 992-8200; (800) 221-5742
Fax   (502) 992-8201
Web   www.zabelzone.com
Product description
Pre-plumbed zone distribution systems.

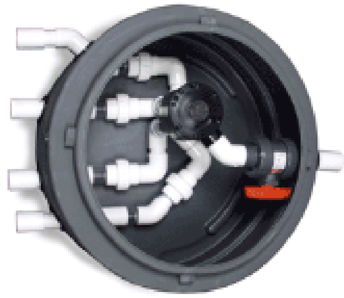

Figure 11-29

Valve automatically advances to distribute wastewater to different zones. (Adapted from Zabel Environmental Technology.)